CLAIMS

1. A solid oxide fuel cell, comprising:

(i) a ferritic stainless steel substrate including a porous region and a non-porous region bounding the porous region;

(ii) a ferritic stainless steel bi-polar plate located under one surface of the porous region of the substrate and being sealingly attached to the non-porous

(iii) region of the substrate about the porous region thereof;

(iv) a first electrode layer located over the other surface of the porous region of the substrate;

(v) an electrolyte layer located over the first electrode layer; and

(vi) a second electrode layer located over the electrolyte layer.

2. The fuel cell of claim 1, wherein the ferritic stainless steel is a ferritic stainless steel containing no aluminium.

3. The fuel cell of claim 1, wherein the ferritic stainless steel is a titanium/niobium stabilised ferritic stainless steel.

4. The fuel cell of claim 3, wherein the ferritic stainless steel contains from about 17.5 to 18.5 wt % Cr (European designation 1.4509).

5. The fuel cell of claim 1, wherein the substrate has a thickness of from about 50 to 250 μm.

6. The fuel cell of claim 5, wherein the substrate has a thickness of from about 50 to 150 μm.

7. The fuel cell of claim 6, wherein the substrate has a thickness of about 100 μm.

8. The fuel cell of claim 1, wherein the porous region of the substrate includes a plurality of through apertures fluidly interconnecting the one and other surface of the substrate.

9. The fuel cell of claim 8, wherein the apertures are uniformly spaced.

10. The fuel cell of claim 8, wherein the apertures have a lateral dimension of from about 5 to 250 μm.

11. The fuel cell of claim 10, wherein the apertures have a lateral dimension of from about 20 to 50 μm.

12. The fuel cell of claim 11, wherein the apertures have a lateral dimension of about 30 μm.

13. The fuel cell of claim 8, wherein the apertures comprise from about 30 to 65 area % of the porous region of the substrate.

14. The fuel cell of claim 13, wherein the apertures comprise from about 50 to 55 area % of the porous region of the substrate.

15. The fuel cell of claims1, wherein the substrate includes an active coating of an electronically-conductive oxide.

16. The fuel cell of claim 15, wherein the active coating is a perovskite oxide mixed conductor.

17. The fuel cell of claim 16, wherein the perovskite oxide mixed conductor comprises $La_{1-x}Sr_xCo_yFe_{1-y}O_{3-\delta}$, where $0.5 \geq x \geq 0.2$ and $0.3 \geq y \geq 0$.

18. The fuel cell of claim 17, wherein the perovskite oxide mixed conductor comprises one of $La_{0.6}Sr_{0.4}Co_{0.2}Fe_{0.8}O_{3-\delta}$, $La_{0.5}Sr_{0.5}CoO_{3-\delta}$, $Gd_{0.5}$ $CoO_{3-\delta}$. and $Sm_{0.5}SR_{0.5}CoO_{3-\delta}$.

19. The fuel cell of claim 15, wherein the active coating comprises doped $LaMnO_3$.

20. The fuel cell of claim 1, wherein the substrate includes a recess in which the first electrode layer is at least partially located.

21. The fuel cell of claim 1, wherein the substrate comprises a foil.

22. The fuel cell of claim 1, wherein the substrate is a photo-chemically machined substrate and/or laser machined.

23. The fuel cell of claims 1, wherein one or both of the first and second electrode layers has a thickness of from about 10 to 25 μm.

24. The fuel cell of claim 23, wherein one or both of the first and second electrode layers has a thickness of from about 10 to 15 μm.

25. The fuel cell of claim 1, wherein one or both of the first and second electrode layers is a sintered material.

26. The fuel cell of claim 25, wherein one of the first and second electrode layers comprises a sintered powdered mixture of perovskite oxide mixed conductor and rare earth-doped ceria.

27. The fuel cell of claim 25, wherein the powdered mixture comprises about 60 vol % of perovskite oxide mixed conductor and about 40 vol % of rare earth-doped ceria.

28. The fuel cell of claim 27, wherein the perovskite oxide mixed conductor comprises $La_{1-x}Sr_xCo_yFe_{1-y}O_{3-\delta}$, where $0.5 \geq x \geq 0.2$ and $1 \geq y \geq 0.2$.

29. The fuel cell of claim 28, wherein the perovskite oxide mixed conductor comprises $La_{0.6}Sr_{0.4}Co_{0.2}Fe_{0.8}O_{3-\delta}$, $La_{0.5}Sr_{0.5}CoO_{3-\delta}$, $Gd_{0.5}Sr_{0.5}CoO_{3-\delta}$. and $Sm_{0.5}Sr_{0.5}CoO_{3-\delta}$.

30. The fuel cell of claims 26, wherein the rare earth-doped ceria comprises $Ce_{1-x}RE_xO_{2-x/2}$, where RE is a rare earth and $0.3 \geq x \geq 0.05$.

31. The fuel cell of claim 30, wherein the rare earth-doped ceria comprises $Ce_{0.9}Gd_{0.1}O_{1.95}$.

32. The fuel cell of claim 26, wherein the one of the first and second electrode layers is the first electrode layer provided as a cathode layer.

33. The fuel cell of claim 26, wherein the other of the first and second electrode layers comprises a sintered powdered mixture of NiO and rare earth-doped ceria.

34. The fuel cell of claim 33, wherein the powdered mixture comprises about 50 vol % of NiO and about 50 vol % of rare earth-doped ceria or un-doped ceria.

35. The fuel cell of claim 33, wherein the rare earth-doped ceria comprises $Ce_{1-x}RE_xO_{2-x/2}$, where RE is a rare earth and $0.3 \geq x \geq 0.05$.

36. The fuel cell of claim 33, wherein the other of the first and second electrode layers is the second electrode layer provided as an anode layer.

37. The fuel cell of claim 36, wherein the rare earth-doped ceria comprises $Ce_{0.9}Gd_{0.1}O_{1.95}$.

38. The fuel cell of claim 1, wherein the electrolyte layer has a thickness of from about 5 to 30 μm.

39. The fuel cell of claim 1, wherein the electrolyte layer comprises a sintered powdered mixture of rare earth-doped ceria and cobalt oxide.

40. The fuel cell of claim 39, wherein the sintered powdered mixture comprises about 98 mole % rare earth-doped ceria and about 2 mole % cobalt oxide.

41. The fuel cell of claim 39, wherein the rare earth-doped ceria comprises $Ce_{1-x}RE_xO_{2-x/2}$, where RE is a rare earth and $0.3 \geq x \geq 0.05$.

42. The fuel cell of claim 41, wherein the rare earth-doped ceria comprises $Ce_{0.9}Gd_{0.1}O_{1.95}$.

43. The fuel cell of claim 1, wherein the electrolyte layer comprises a sintered layer of doped ceria.

44. The fuel cell of claim 1, wherein an array of elements each comprising a first electrode layer, an electrolyte layer and a second electrode layer are provided upon said substrate.

45. A fuel cell stack comprising a plurality of the fuel cells of any of claims 1 to 43.